MISSOURI DEPARTMENT OF NATURAL RESOURCES

40 years

Celebrating 40 years of taking care of Missouri's natural resources.

The Role of Science in Preparing for and Responding to Natural Disasters

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Department of Natural Resources
Springfield, Missouri, November 2014

Desired Outcomes

- Public health and safety
- Economic protection
- Resiliency

Preparedness and risk reduction

- Extreme weather events
- Climate forecasting
- Improved land use planning
- Improved building design
- Insurance predictability
- Develop better and more effective disaster plans

Effective interaction of science, policy and practice

- Science can inform policy and practice
  - Enhanced communication with policy makers and response agencies
  - Apply what we learn
  - Play an integral role in response planning

Effective interaction of science, policy and practice

- Develop science research agendas with stakeholders
  - Mitigation efforts that are useful and implemented
  - Better use of resources
  - Measureable success

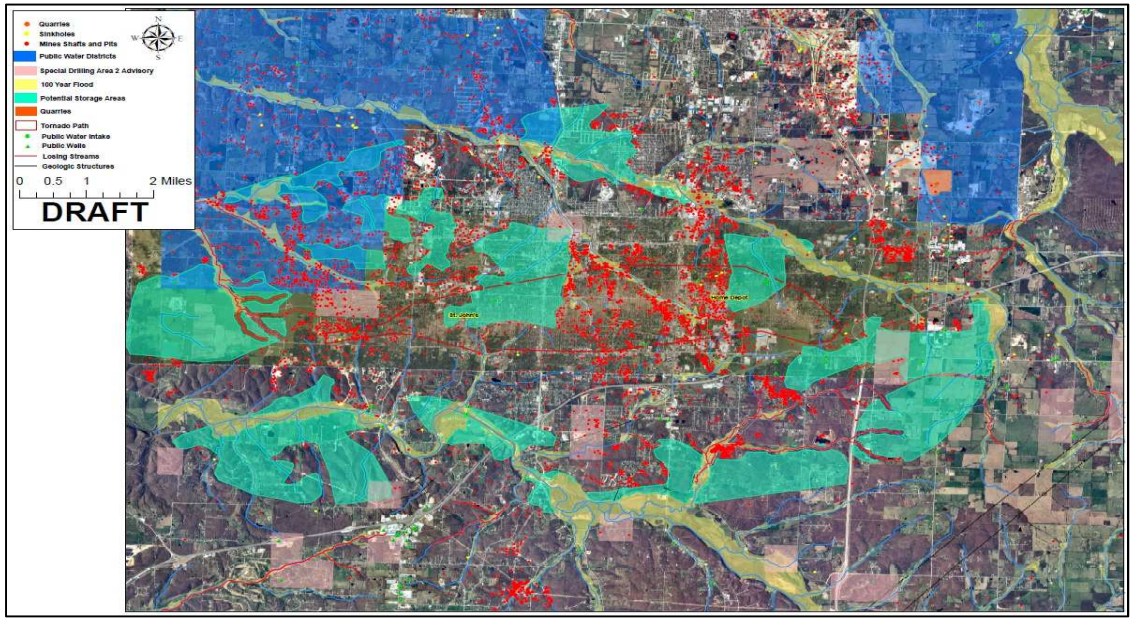
Case Study 1 – Joplin Tornado

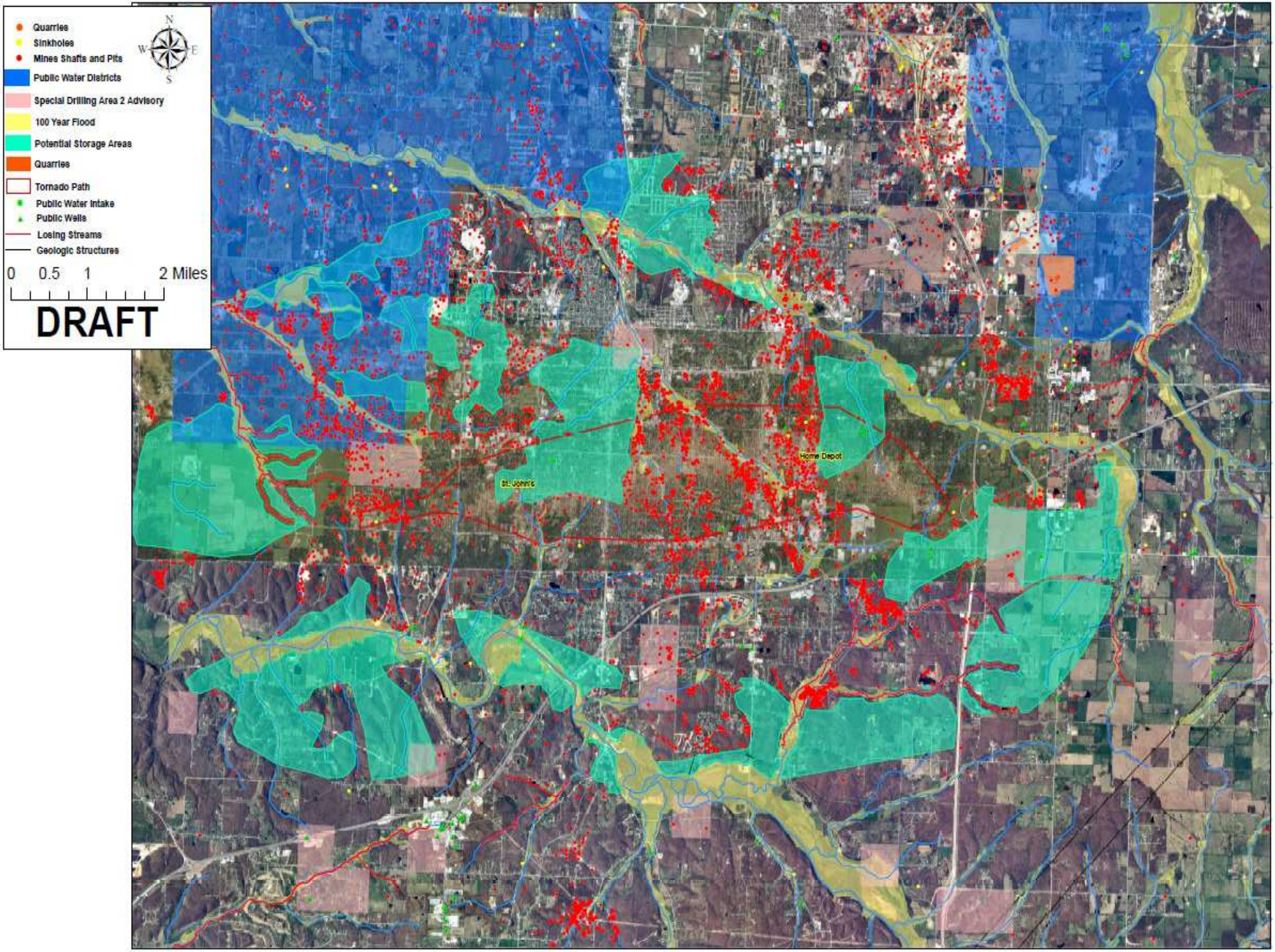
Case Study 1 – Joplin Tornado

- Joplin, Missouri, May 22, 2011
  - 8,000+ structures damaged or destroyed
  - Nearly $3 billion in losses

Case Study 1 – Joplin Tornado

- Geologic/hydrologic environmental limitations
- Legacy subsurface mining




Quarries
Sinkholes
Mines Shafts and Pits
Public Water Districts
Special Drilling Area 2 Advisory
100 Year Flood
Potential Storage Areas
Quarries
Tornado Path
Public Water Intake
Public Wells
Losing Streams
Geologic Structures
N
W
E
S
0 0.5 1 2 Miles
DRAFT
Home Depot
St. John's

Case Study 2 – Drought 2012

Case Study 2 – Drought 2012

- Worst drought in 60 years
- All Missouri counties declared disaster areas by mid-July

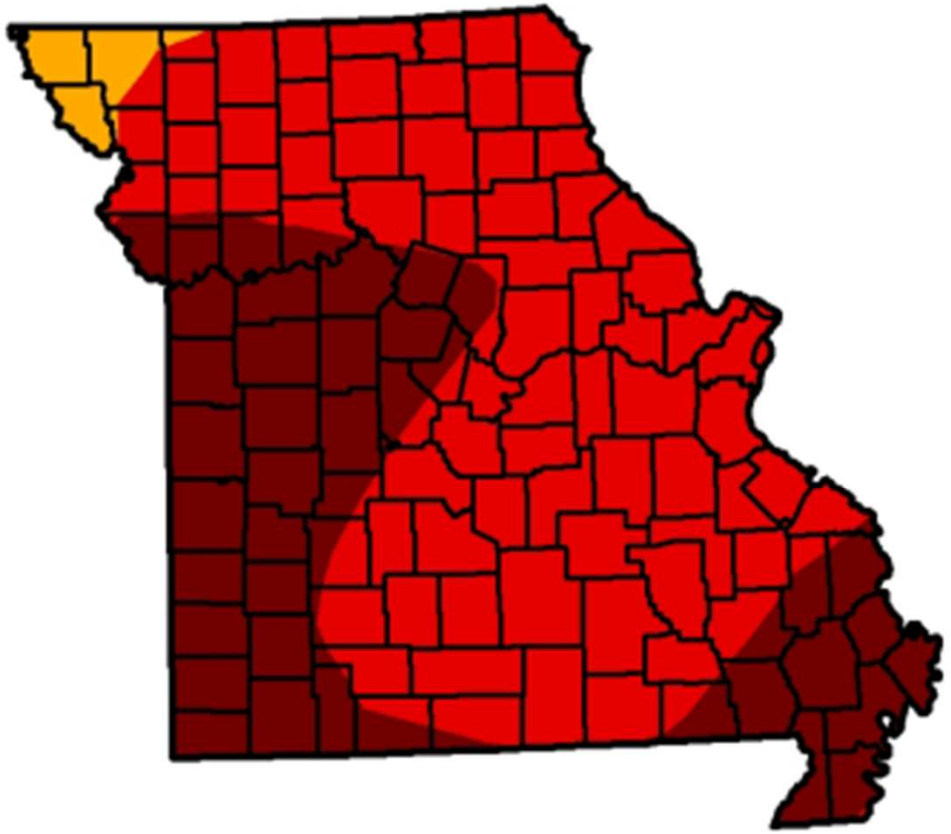
U.S. Drought Monitor

Missouri

August 28, 2012
Valid 7 a.m. EST

Drought Conditions (Percent Area)

	None	D0-D4	D1-D4	D2-D4	D3-D4	D4
Current	0.00	100.00	100.00	100.00	97.44	35.29
Last Week (08/21/2012 map)	0.00	100.00	100.00	100.00	99.29	35.72
3 Months Ago (05/29/2012 map)	44.73	55.27	19.40	2.52	0.00	0.00
Start of Calendar Year (12/27/2011 map)	95.48	4.52	0.00	0.00	0.00	0.00
Start of Water Year (09/27/2011 map)	55.19	44.81	22.45	8.65	0.00	0.00
One Year Ago (08/23/2011 map)	44.91	55.09	16.87	4.28	0.00	0.00



Intensity:

- D0 Abnormally Dry
- D1 Drought - Moderate
- D2 Drought - Severe
- D3 Drought - Extreme
- D4 Drought - Exceptional

The Drought Monitor focuses on broad-scale conditions. Local conditions may vary. See accompanying text summary for forecast statements.

http://droughtmonitor.unl.edu

USDA National Drought Mitigation Center

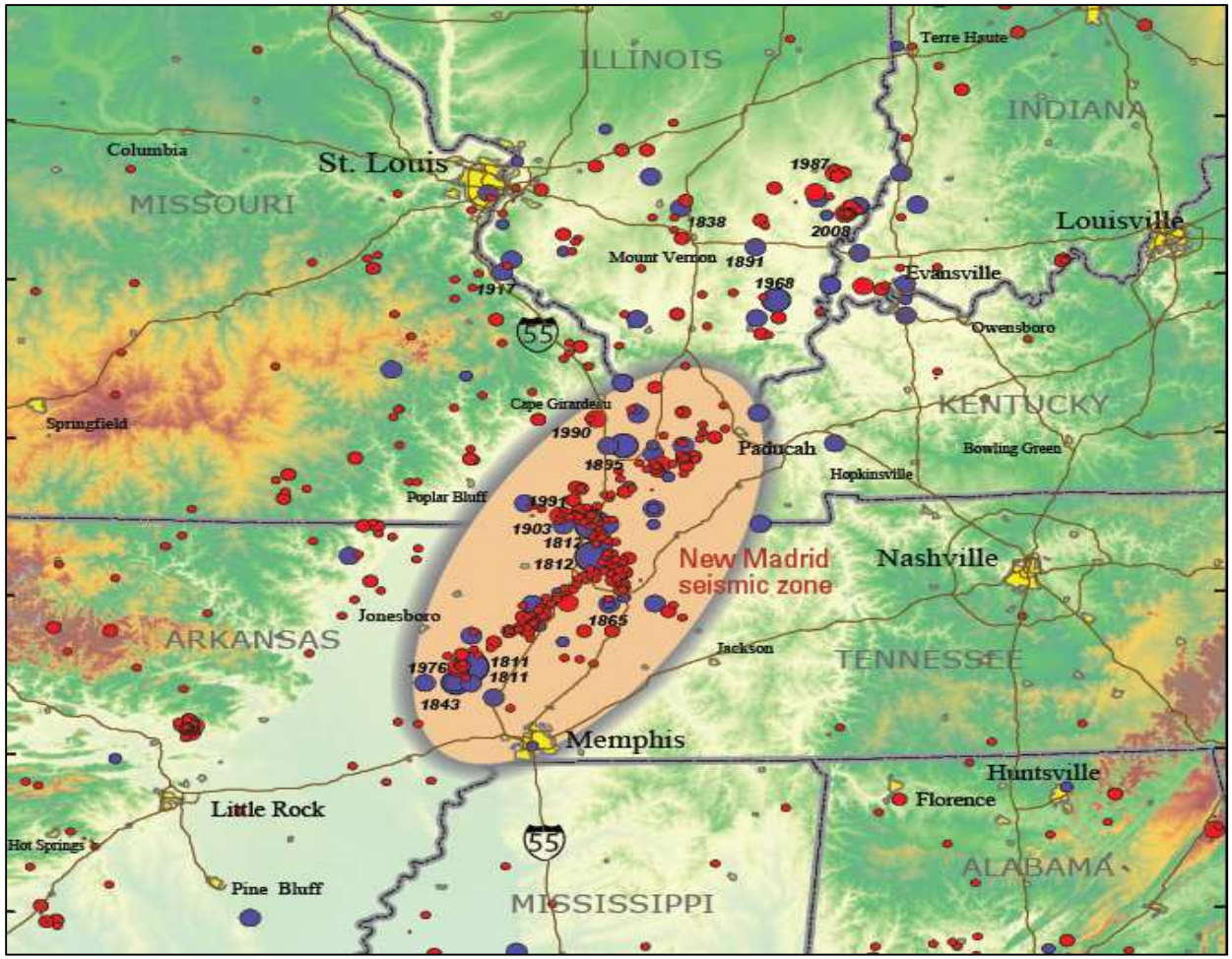
Released Thursday, August 30, 2012
Brian Fuchs, National Drought Mitigation Center

Case Study 2 – Drought 2012

- Monitoring networks to support predictability models
  - Surface water
  - Groundwater

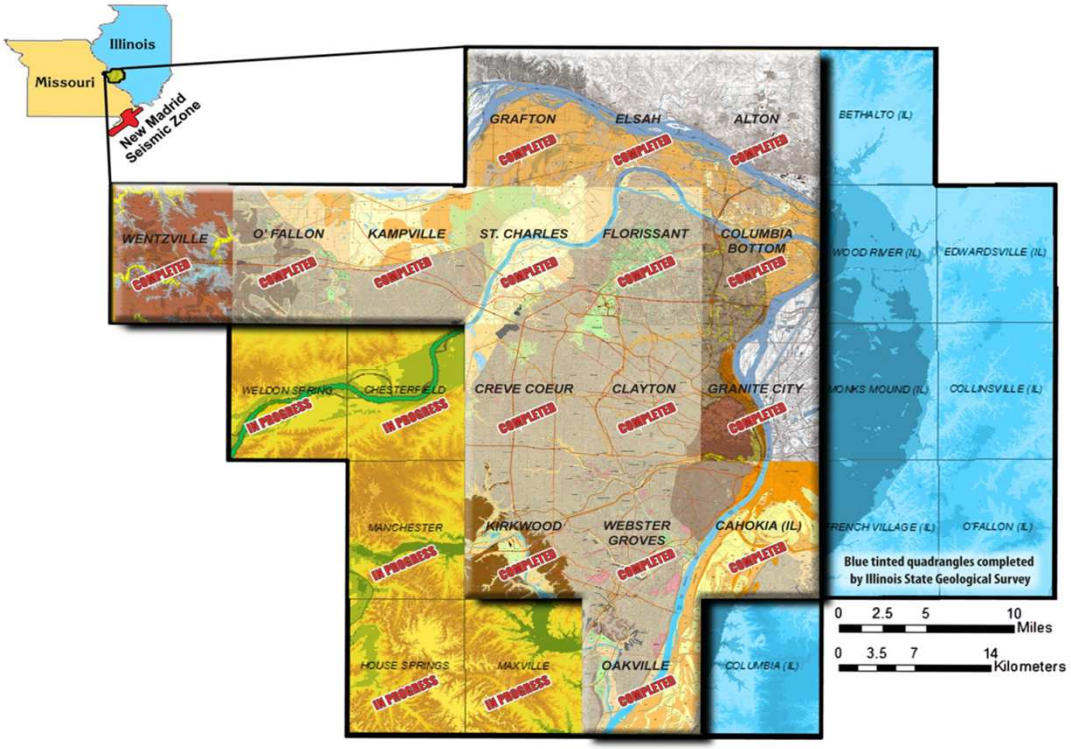
- Identify areas prone to water supply shortage
- Considerations of adding water supply

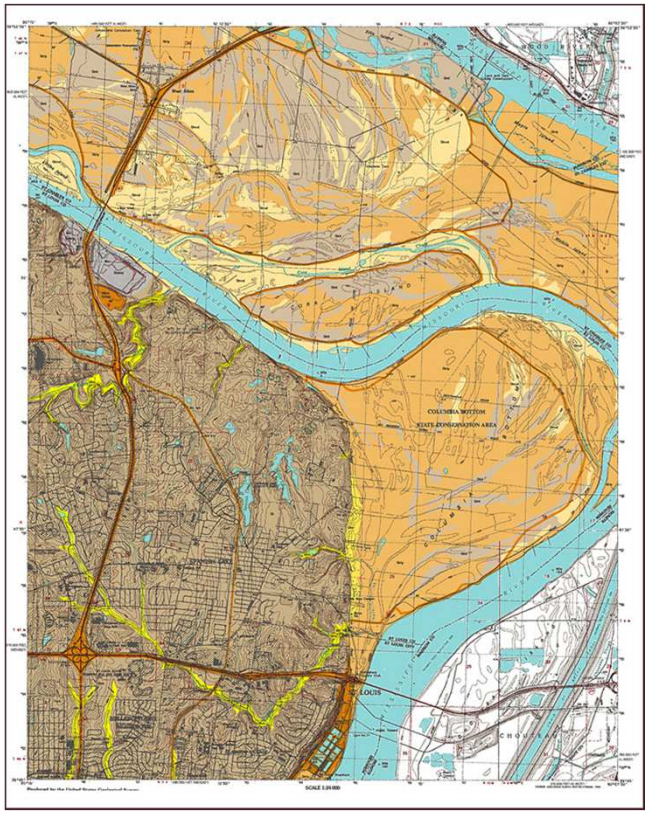
Case Study 3 – Seismic Hazards



Case Study 3 – Seismic Hazards

- Intensity of shaking based upon geologic conditions





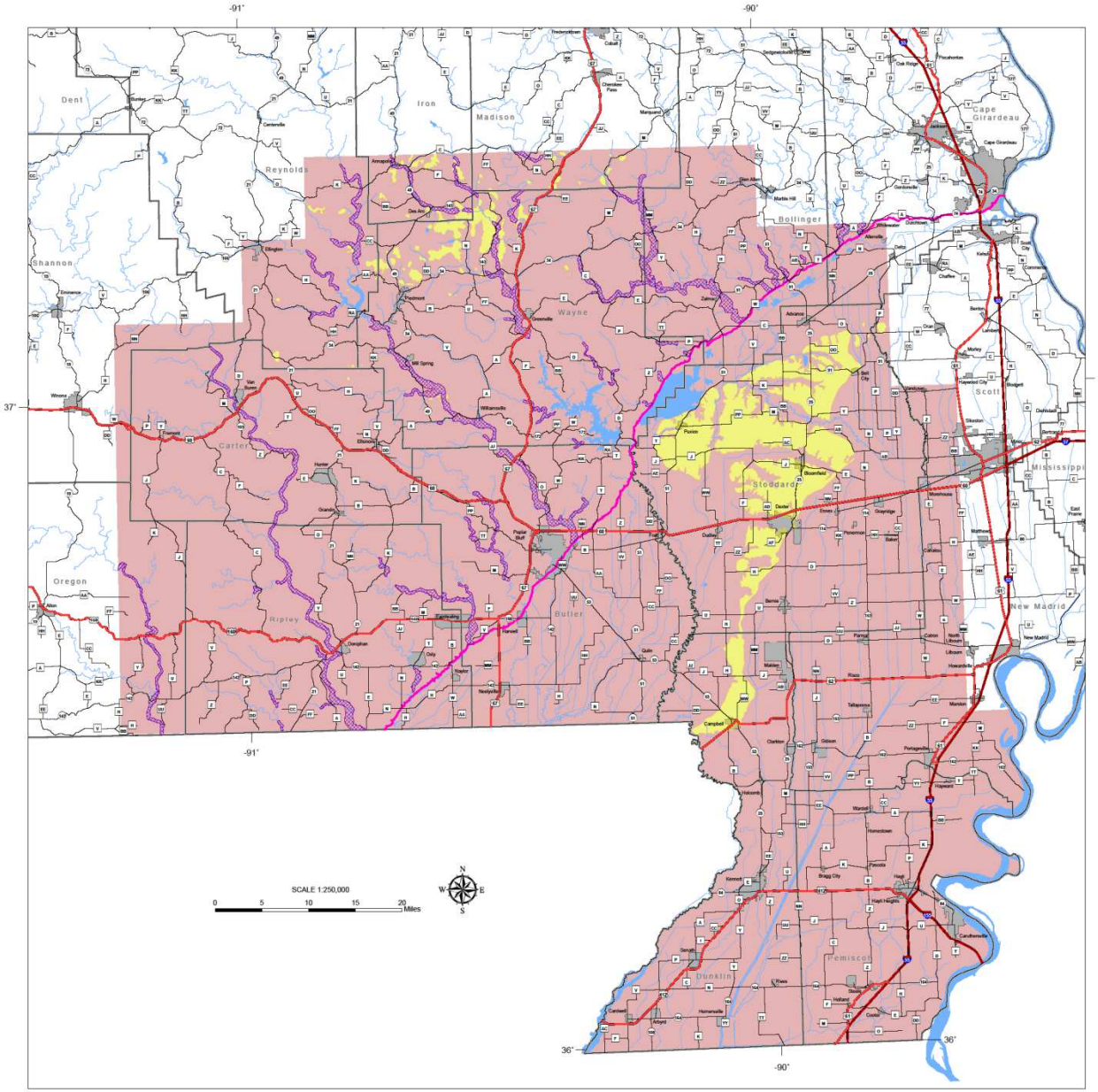
Case Study 3 – Seismic Hazards

- Damage prediction
  - Construction standards
  - Engineered structures
  - Response planning
  - Loss estimation
  - Facility placement

- Monitoring networks to enhance predictability

Case Study 3 – Seismic Hazards

- Lessons learned from Joplin
  - Debris management
  - Environment



GENERAL GEOLOGICAL LIMITATIONS FOR SANITARY AND DEMOLITION LANDFILLS IN THE POPLAR BLUFF, MISSOURI AREA

Digital Compilation by
Airin Haselwander

2014

OFM-13-641-GS

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SEMA MAP 14 GRANT

INTRODUCTION

This map is designed as a tool for disaster planners, emergency managers and local communities for the long- and short-term disposal of demolition and reconstruction waste in the event of a major natural disaster, including weather related disasters such as tornadoes, severe ice storms or an earthquake in the New Madrid Seismic Zone. The information provided on this map may also be useful to land use planners and regulatory agencies as a generalized guide for locating potential areas suitable for a solid waste disposal facility.

The primary data used to construct this map includes existing Missouri Geological Survey (MGS) and U.S. Geological Survey (USGS) geologic mapping, MGS losing stream data files, Federal Emergency Management Agency (FEMA) flood data files and MGS well log data. Quality of the data sources varies according to original scale, data type and location.

The determination of geologic and hydrologic limitation is based on the criteria set forth in *10 CSR 80-2.015(3)(A)(1)(A)(1-VI), Preliminary Site Investigation, Detailed Site Investigation Workplan, and Detailed Site Investigation and Characterization Report.*

> "Sites proposed for sanitary or demolition waste landfills known to have one or more of the following geologic or hydrologic conditions within its boundaries are considered unsuitable for the development of a solid waste disposal area: (I) groundwater that must be pumped in order to keep waste within the proposed solid waste disposal area isolated above the water table; (II) permeable geologic media, including soil or bedrock with karst terrane features, faults, joints, fractures, or voids, that provide a pathway for the rapid migration of fluids from the site into the uppermost regional aquifer or the rapid migration of groundwater from the site to a surface water body outside of the site; (III) permeable geologic media, including soil or bedrock with karst terrane features, faults, joints, fractures, or voids, that provide a pathway for the migration of landfill-derived gases outside of the site; (IV) a fault that has experienced movement during the Holocene epoch that is located within the boundaries of the proposed solid waste disposal area; (V) groundwater that cannot effectively be monitored on-site due to karst terrane conditions or (VI) the presence of subsurface voids or conditions that present a significant potential for catastrophic collapse."

MAP INFORMATION

Existing geologic mapping and well logs were used to determine the location of potential sites for sanitary or demolition landfills while losing streams and flood plain data were used to determine possible locations for 90-day storage (FEMA 2008, 2012; Missouri Department of Natural Resources (MoDNR) 2006a, 2011, 2012b, 2013; Stewart and Mcmanamy, 1981a, 1981b; and Stewart et al., 1981a, 1981b).

The map scale and data source limitations required combining areas of diverse character into a smaller number of generalized units. Small areas of significant geologic limitations may be included in a larger area mapped as moderate to slight geologic limitations; small isolated areas of moderate to slight geologic limitations may have been omitted. Therefore, the map should not be used for site-specific applications such as evaluation of the landfill site potential of an individual land parcel or structure. The potential delineations of this map are inappropriate for such things as land zoning, building code requirements or defining insurance rate zones.

SITE SUITABILITY FOR LONG-TERM DISPOSAL

Area of Moderate to Slight Geologic Limitations

Sites proposed for sanitary or demolition waste disposal areas require the presence of low-permeability geologic media that inhibits the movement of fluids into the uppermost regional aquifer (State of Missouri, 2013). Areas along Crowley's Ridge where clay units such as the Porter's Creek Clay were considered to exist within 100 feet or less of the ground surface were included in the moderate to slight geologic limitations. Scattered areas of moderate to slight geologic limitations exist across the northern portion of the map. These areas have Precambrian igneous units of granitic or rhyolitic composition bedrock exposed at the surface and typically have limited hydraulic conductivity. The valleys between the igneous highs (often called "knobs") may have a thin mantle of Paleozoic sedimentary rocks present, but are often highly fractured and faulted. A detailed investigation would be required to determine if the subsurface igneous bedrock is considered a permeable geologic media.

Areas of moderate to slight geologic limitations were determined using existing well log data, geologic mapping, losing stream data, and reconnaissance field work (MoDNR 2006a, 2011, 2012b, 2013; Stewart and McManamy, 1981a, 1981b; and Stewart et al., 1981a, 1981b).

Area of Significant Geologic Limitations

Based on 10 CSR 80-2.015, a solid waste facility is considered unsuitable if it is underlain by "…Permeable geologic media, including soil or bedrock with karst terrane features, faults, joints, fractures, or voids, that provide a pathway for the rapid migration of fluids from the site, …" Based on the absence of low permeable geologic media, both the uplands and the Mississippi Embayment floodplain are considered to have significant geologic limitations. The Mississippi Embayment has a shallow depth to groundwater and is underlain by sand, silt and gravel. The upland portions of the map are underlain by Paleozoic Cambrian- through Ordovician-age bedrock consisting primarily of carbonates and sandstones. These bedrock units compose the Ozark Aquifer. Geologic mapping and well log data do not reveal any low permeability geologic media present beneath the project area (MoDNR 2006a, 2012b; Stewart and McManamy, 1981a, 1981b; and Stewart et al., 1981a, 1981b).

Areas of significant geologic limitations were determined using well log data, geologic mapping, losing stream data and reconnaissance field work (MoDNR 2006a, 2011, 2012b; Stewart and McManamy, 1981a, 1981b; and Stewart et al., 1981a, 1981b).

SITE SUITABILITY FOR SHORT-TERM STORAGE

Storage facilities for the short-term holding and processing of demolition waste are crucial for an organized and efficient emergency response. These temporary facilities often do not warrant the regulatory requirements of a long-term solid waste facility as established by 10 CSR 80-2.015; therefore, it is important that the underlying geologic and hydrologic conditions of any site possess a low risk or a low potential for long-term groundwater contamination.

The areas of this project determined to be most suited for temporary facilities are those located in a discharge setting not directly overlying a regional aquifer. These locations are typically alluvial valleys, within the 100-year flood zone, where the groundwater contamination potential is limited to surface waters or narrow alluvial aquifers. Stream valleys with at least 660 feet of continuous floodplain along rivers and streams and greater than 1,320 feet from lakes or major water impoundments were selected as potential sites for short-term storage, since they provide sufficient working space for machinery and equipment as well as a sufficient buffer adjacent to the stream channel (FEMA 2008, 2012).

LEGEND

- Areas of Severe Geological Limitations for Long-Term Disposal
- Areas of Moderate to Slight Geological Limitations for Long-Term Disposal
- Areas Potentially Suitable for Short-Term Storage
- Interstate Highways
- U.S. Highways
- State Highways
- Upland/Lowland Boundary
- County Boundary
- Rivers
- Lakes
- Municipalities

LOCATION MAP

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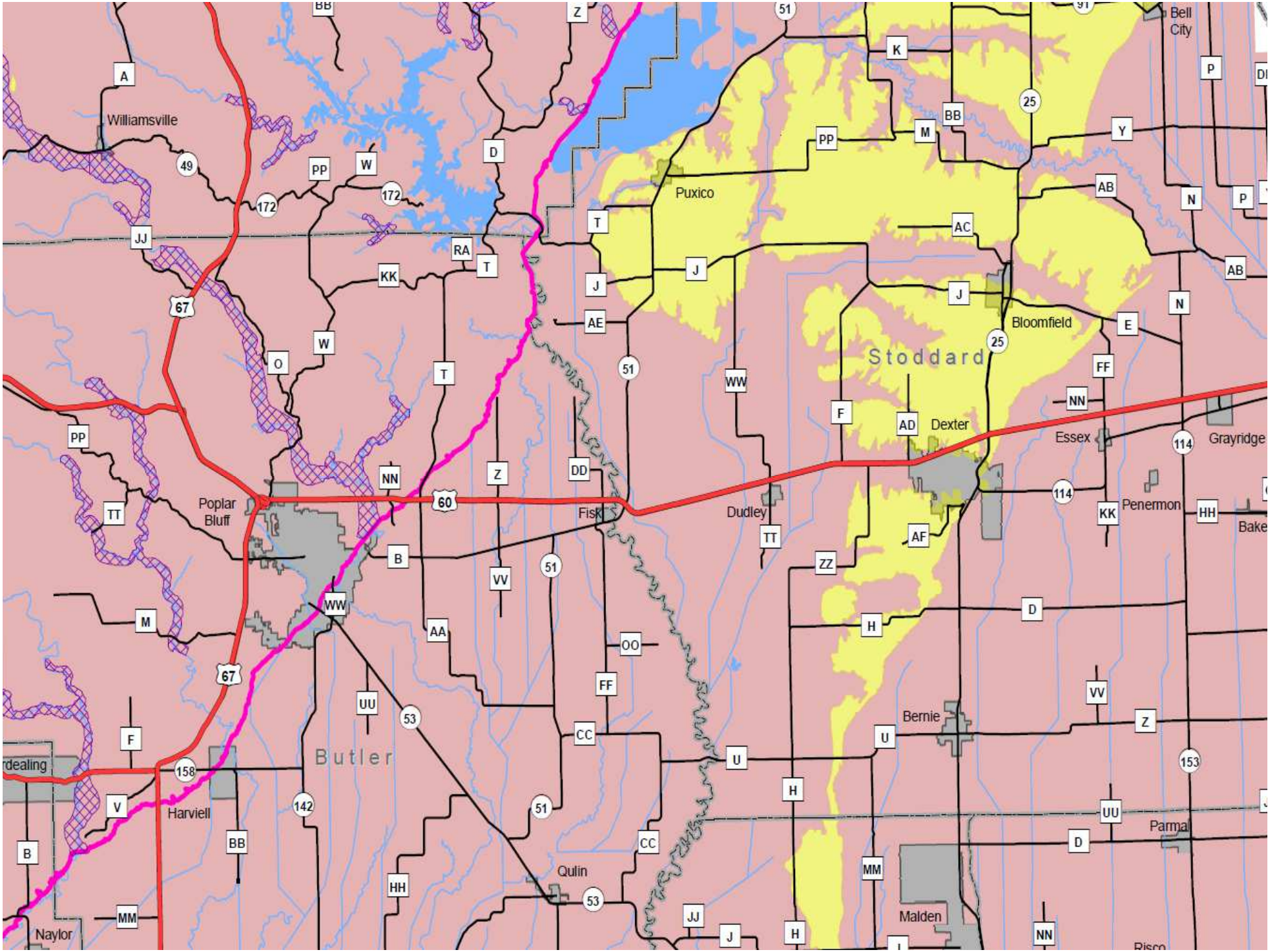
Williamsville
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Bell City
Bloomfield
Stoddard
Dexter
Essex
Grayridge
Penermon
Poplar Bluff
Fisk
Dudley
Butler
Harviell
Bernie
Parma
Malden
Qulin
Naylor
Risco
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Conclusion

- Applied to mitigate risk and provide input into effective response and recovery
- Prediction and prevention
- Part of the solution to an integrated, multidisciplinary approach to increasingly uncertain scenarios
- Health and safety, economic security, resiliency

Thank you